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September 18, 2000

The Commissioner of Patents and Trademarks
Washington, D.C. 20231
U.S.A.

Sir:

Re: New United States Patent Application
Inventor(s): Shaath et al.
Title: METHOD AND SYSTEM FOR ELECTRONIC FILE LIFECYCLE
MANAGEMENT
Our File: 88-06 US

Enclosed for the filing of a new patent application in the United States are:

1. Small Entity form – completed;
2. Assignment and Assignment Cover Page;
3. Declaration signed by the Inventor(s);
4. 32 pages of specification, 59 claims, 7 being independent; Abstract of the Disclosure;
5. Formal drawings including 7 figures;
6. A cheque in the sum of \$852.00 to cover the filing fee;
7. A cheque in the sum of \$40.00 to cover the assignment fee.

We will be pleased to receive the filing particulars of this application. Enclosed is a self-addressed return postcard to indicate that the application has been received by the USPTO.

Please charge any additional fees or credit overpayment to Deposit Account No: 50-1142.

Respectfully submitted,



Gordon Freedman
Regn. No. 41,553

VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) & 1.27(c)) - SMALL BUSINESS CONCERN		Attorney Docket No. 88-06 US
Applicant or Patentee: KAMEL SHAATH; YAQIN FU; VINAY PAKTHASARATHY; ALEXIS JELVIS; ADEL L. LIYANSKY		
Serial or Patent No:		
Filed or Issued:		
Title: METHOD AND SYSTEM FOR ELECTRONIC FILE LIFECYCLE MANAGEMENT		
I hereby declare that I am <input type="checkbox"/> the owner of the small business concern identified below: <input checked="" type="checkbox"/> an official of the small business concern empowered to act on behalf of the concern identified below:		
NAME OF SMALL BUSINESS CONCERN KOM INC.		
ADDRESS OF SMALL BUSINESS CONCERN 4019 CARLING AVENUE, OTTAWA, ONTARIO, CANADA K2K 2A3		
I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.		
I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, described in:		
<input checked="" type="checkbox"/> the specification filed herewith with title as listed above. <input type="checkbox"/> the application identified above. <input type="checkbox"/> the patent identified above.		
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Each person, concern or organization having any rights in the invention is listed below:		
<input checked="" type="checkbox"/> No such person, concern, or organization exists. <input type="checkbox"/> Each such person, concern, or organization is listed below.		
Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)		
I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))		
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such wilful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.		
NAME OF PERSON SIGNING <u>KAMEL SHAATH</u>		
TITLE OF PERSON IF OTHER THAN OWNER <u>V.P. ENGINEERING</u>		
ADDRESS OF PERSON SIGNING <u>4019 CARLING AVENUE, OTTAWA, ONTARIO, CANADA K2K 2A3</u>		
SIGNATURE <u>[Signature]</u> DATE <u>15 September 2000</u>		

Method and System for Electronic File Lifecycle Management

Field of the Invention

The invention relates generally to storage devices for storing electronic data and more particularly to virtual storage devices for electronic file lifecycle management.

5 Background of the Invention

In the past, files were stored as paper documents within a physical file. A physical file has a physical lifecycle from file creation to file destruction. Commonly, during this process, the file goes through the process of file building, file reference, file non-use, and file archiving. These steps often occur in that order though this need not be the case.

10 Because of the way files are maintained within present day computer systems, it is often difficult to retrieve files when lost. This is not because of backup failures and so forth, so much as due to poor organization and non-standard file lifecycle management. Typically, files are relocated manually which necessitates human interaction and the new location of the file has to be manually recorded. This process is prone to errors since it
15 relies heavily on the individual to update the current location. For example, it is often only a guess when a specific file is archived. The name and location of the file may also be inexact. This leads to difficulties in accessing data once archived. It also leads to difficulty in accessing data during normal use.

The adoption of the concept of electronic file storage has increased the demand
20 for storage on an ongoing basis. Huge networked storage repositories, which were once considered as unattainable, are now more widely available. The potential existence of such systems raises many questions of how to organize and coordinate where the files will be stored and for how long. These issues have plagued system administrators through out the evolution of the electronic age, and will continue in the future as the demand for
25 electronic data increases. In most organizations their storage requirements are evolving at an exponential rate exceeding all expectations. This phenomenon along with the ongoing advancements in storage technologies that are occurring at a very fast rate are making existing storage repositories obsolete shortly after their deployment.

Object of the Invention

In order to overcome these and other limitations of the prior art, it is an object of
5 the present invention to provide a method and system for automatic management of
electronic file lifecycles.

Summary of the Invention

The embodiment of this invention enables organizations to salvage their existing
investments in current storage technologies while allowing the adoption and
10 incorporation of up and coming technology in one comprehensive system. Existing
systems that are currently in production may be utilized to maintain some data while the
newer more efficient storage systems may maintain the most current data. The invention
supports incorporation of the widest variety of storage technologies and systems into a
cohesive and homogeneous storage system that can expand and incorporate newer
15 storage technologies as they become available and continue to meet the ever expanding
demand for storage.

Typically, the file lifecycle allows the file to be accessed throughout its existence,
regardless of where it is located within the network. A file may exist on any of the
storage components or servers that comprise a virtual storage space. All relevant
20 information regarding file management policies is maintained and enforced according to
the invention for the entire file lifecycle. Several instances of a file may exist within a
virtual space allowing the overall system to perform such tasks as load balancing, high
availability, replication, backup and mirroring. This implies that for the entire lifespan of
the file it will remain accessible.

25 According to the present invention there is provided a method of managing a file
lifecycle comprising the steps of:
storing the file on a storage medium having associated therewith a set of policies relating
to file storage locations;

determining from the associated policies when the file is to be moved;
moving the file to another storage location within a same or different storage medium
when the file is to be moved.

- 5 According to another embodiment of the invention there is provided a method of
managing a file lifecycle comprising the steps of:
providing a virtual storage medium having a plurality of storage media associated
therewith and having associated therewith a set of policies relating to file storage
locations within the storage media;
- 10 storing the file on a storage medium within the virtual storage medium;
at intervals, determining from the associated policies actions dictated by the policies for
performance on the files;
performing the dictated actions on the file.
- 15 According to another embodiment of the invention there is provided a method of
managing a file lifecycle comprising the steps of:
providing a virtual cabinet having a plurality of virtual drawers, each virtual drawer
associated with at least a storage medium and a single drawer associated with storage
media of a similar nature;
- 20 providing a plurality of policies, a policy associated with each virtual drawer;
storing the file in a virtual drawer by storing the file on at least a storage medium
associated with the virtual drawer;
at intervals, determining from the policy associated with the virtual drawer an action
dictated by the policy; and,
- 25 performing the dictated action on the file.

The process of relocating a file could be triggered externally by an administrator, or be
triggered by usage policies such as high & low watermarks or by a predefined event or
interval.

According to yet another embodiment of the invention there is provided a method of managing a file lifecycle comprising the steps of:

providing a virtual cabinet having a plurality of virtual drawers, each virtual drawer associated with at least a storage medium and a single drawer associated with storage

media of a similar nature;

providing a plurality of policies, general policies on a virtual cabinet basis as well as policies associated with each virtual drawer;

storing the file in a virtual drawer by storing the file on at least a storage medium associated with the virtual drawer;

upon receiving an access request to access the file, determining from the policy associated with the virtual drawer an action dictated by the policy;

performing the dictated action on the file.

Advantageously, maintaining an index of the relevant information to access the files regardless of the location allows a single file to have several extents potentially spanning across several of the storage components within a virtual drawer or across several virtual drawers within a virtual cabinet. The entire file remains accessible and appears to the user completely intact as one whole file even though it might be spliced across different partitions on different servers, but this need not be so.

Brief Description of the Drawings

The invention will now be described in conjunction with the drawings in which:

Fig. 1 is a simplified diagram of a filing cabinet;

Fig. 2 is a simplified diagram of a virtual filing cabinet;

Fig. 3a is a simplified diagram of a visualization of a virtual volume comprising three virtual filing cabinets;

Fig. 3b is a simplified block diagram of physical storage devices relating to the virtual volume of Fig. 3a;

Fig. 4 is a simplified flow diagram of a method of file lifecycle management;

Fig. 5 is a simplified flow diagram of an implementation of the system for Windows

NT®; and,

Fig. 6 is a simplified flow diagram of a method of using retention dates to track file lifecycles.

Detailed Description of the Invention

Referring to Fig. 1, a simplified diagram of a file cabinet 1 is shown. The drawers 2, 3, 4, and 5 each hold a finite number of files. The drawers are of equal size and typically, each drawer is labeled, as shown, to indicate its contents. The file cabinet 1 contains files organized into A-J (drawer 2), K-Z (drawer 3), archives (drawer 4) and accounting (drawer 5). Such organization methods and filing systems are well known and their use in offices is widespread.

As noted above, the concept of file folders has been adopted for use in graphical user interfaces. The file folder is a graphical representation of a directory. A file folder may contain documents or further file folders and so forth. This is seen in the Macintosh® operating system and in Windows® operating systems. The use of these file folders is merely a convenient visualization tool for users. In actual practice, a single file folder is rarely comprised of many nested file folders and so forth.

Referring to Fig. 2, a simplified diagram of a virtual file cabinet 21 used as an aid for visualizing a computer file system is shown. The virtual cabinet 21 has a number of drawers, each labeled to reflect their contents. The drawers are indefinite in size and may span more than a single physical storage medium. Some drawers may reflect storage media types as opposed to permanent storage. For example, the drawer 22 is a cache. The cache is shown labeled “cache drawer” but may in fact be labeled disk surface or to be filed or so forth. The drawer 23 is a storage medium that is currently available. Because the system uses virtual volumes, it is possible that a storage medium is offline. Of course, even when virtual volumes are not used, a network drive may be offline at a particular time. Drawer 24 relates to a magneto-optical drive for storing large volumes of data on removable media. Drawer 25 relates to a recycle bin or trash where deleted files are stored prior to being permanently erased. Finally, an offline media drawer 26 is a placeholder that retains information about for all components of the specific virtual cabinet that are currently unavailable and may be inaccessible. An Offline Media Drawer

contains information related to all removable media that is not currently accessible. Of course, any drawer can be in an unavailable state due to a network or hardware related problem. Each Drawer has its own independent operational status that reflects its current state; these states include on-line/off-line, locked/unlocked as well as replicating, mirror synchronization, and backup in progress. A virtual cabinet or an individual drawer can be online or offline indicating that it is accessible or not. Additionally, they may be locked or unlocked indicating that for some administrative purpose the drawer is not accessible to a particular user/group or to the entire enterprise.

Associated with the virtual cabinet 21 is a set of cabinet policies relating to version control of files, security access, deletion, file archiving, and so forth. Further, associated with each drawer is a set of policies relating to that drawer. Some examples of policies for each drawer are set out herein below.

Referring to Fig. 3a, a simplified block diagram of a system 30 having a virtual volume 31 in the form of a virtual storage space, and virtual filing cabinets 32 defined therein is shown. A lifecycle of a file stored within a virtual drawer is controlled in a fashion that makes use of policies of that drawer, of the virtual cabinet in which the drawer is located and of the virtual volume. In combination, these policies define a set of policies for governing files in the specified virtual drawer 33. Typically, the files within a single virtual cabinet 32 are inside a single virtual subdirectory, but this need not be so. Additionally, the files within a single virtual drawer 33 may be inside an associated single virtual subdirectory, but this need not be so.

Individual data files are stored within virtual drawers 33. These drawers 33 expand and shrink dynamically and are typically constituted by a homogeneous media type. Besides storage, virtual drawers 33 are also defined for other purposes such as caching, redundancy control (such as backup, mirror & replica), file recycling and offline media management, as well as recycling. For example, the caching drawer 21 would reflect a storage medium providing high performance such as RAM.

Referring to Fig. 3b a physical system is shown comprising different storage media for storing different data within different drawers. A network is shown comprising a plurality of computer systems 34. Each system includes RAM 35, non-volatile storage devices and so forth. The non-volatile storage devices include hard drives 36, magneto
5 optical drives 37, CD ROM writers 38, DVD with its different flavours of DVD-RAM, DVD-ROM, DVD-R, DVD-RW, DVD+RW, etc. as well as flash disks, tape and other forms of storage. Each physical device is associated with one or more cabinets and with one or more drawers.

10 Referring to Fig. 4 a simplified flow diagram of a method of file lifecycle management is presented. The goal of file lifecycle management is generally to control a file from its inception, throughout all stages of its existence. If a lifecycle management system is complete, it safely ensures information availability and simultaneously provides a cost effective storage location for each file, according to predefined administration
15 policies. The life cycle of the file could include policies that determine when it will expire and at the administrators discretion be automatically disposed of and deleted securely or moved to the recycle bin.

Each virtual cabinet contains general policies to be applied for the files under its control; in turn, each Virtual Drawer in a cabinet includes further rules for administering
20 files in its domain. Further, it is possible that within a virtual storage space, there are high-level policies that apply to all files.

A file is created and placed within a file folder. The file folder is similar to those known in the art and, typically, relate directly to directories. The drawer typically relates to a higher-level directory. The drawer has policies, which include policies of the cabinet
25 and may further include system level policies such as those of the virtual volume and so forth. These policies are used to evaluate a lifecycle stage of a file within the drawer and to determine a subsequent drawer where the file folder will be stored within the virtual cabinet. Upon storage of the file within a folder within the drawer, the policies are monitored, as is the file to determine when each or any policy is applicable. When a
30 policy is applicable, it is applied to the file or to the drawer as required. The use of

storage cabinet or drawer is completely transparent to the user. As far as the user is concerned the file is stored in a particular directory on a particular drive. Internally to the system the file may be redirected to an entirely different location and may even be split across different devices across the network. The internal directory structures as well all the policy enforcement and file management is handled and maintained according to the inventive method (metadata).

Similarly, in the other portion of the flow diagram of Fig. 4, a file is accessed. Upon the file being accessed, the policies are checked to determine any that relate to files being accessed that are within the drawer. Those applicable policies are implemented and the policies of the drawer are maintained. Of course, numerous other actions may trigger policies. Typical examples of these include deleting files, moving files, copying files, and so forth. Each of these actions may be considered a file access operation.

In essence, implementation of policies allows for automated file lifecycle management. For example, a virtual cabinet is constituted by virtual drawers and sets of rules. The rules relate to aspects of file lifecycle management. Some examples of policy areas and implementations are set out below.

File retention policies are one of the most important aspects of file lifecycle management. These policies determine how files are removed from a system. For example, in Windows 98® a file, when deleted from a hard disk drive is placed in a recycle bin from which it is only removed when the recycle bin is emptied. Though this provides convenient retrieval of accidentally deleted files, it is not akin to file lifecycle management.

For example, using policies, a cause and a respective action are set out. For file retention, these actions include file deletion, file deletion with security to prevent retrieval, file archiving, file locking to prevent deletion, moving a file to a different drawer and so forth. A typical file retention policy for the virtual cabinet of Fig. 2 is as follows:

Cache Drawer: If file is saved, transfer file to online one (drawer 23).

Online One: If file is not accessed for 30 days transfer to MO One (drawer 24).

If file is deleted, transfer to Recycle Bin (drawer 25).

MO One: If file is not accessed within 30 days,

5 Store the file on a removable WORM storage medium.

If file is accessed more than 5 times within 30 days,

Transfer file back to online one (drawer 23).

Recycle Bin: If file is not restored in 30 days,

Store file on a non-volatile storage medium and delete.

10 Here, a file is stored in the cache until it is saved or it may be saved to any other drawer according to a predefined policy. Once saved it is placed in the file drawer automatically. It remains there during use. Once the file is not accessed for a period of time, the file is transferred to an MO drawer where it is stored in a less conveniently accessible medium. It remains there during a period of intermittent use. Should the file be
15 used often, it will be transferred back to one of the more accessible drawers such as the active file drawer 23. When no use of the file is made for a period of time, it is archived. Archiving of the file takes the form of transferring it to a removable medium. This operation may take place at intervals depending on the size of the removable media, the size of the organisation and the size of the virtual cabinet. As noted, even deleted files
20 may be archived for later retrieval according to the invention. By maintaining an index of files and their locations, it becomes a simple matter to find a file whether deleted, archived, or active.

25 Though the above example is quite simple, far more complex file management policies are possible. For example, some files may be deleted without archiving. These would include highly secure files, which are subject to secure deletion, personal files that

are not necessary for the company operations, and so forth. Also, some files that are replaced may be deleted in order to replace same instead of simply accessed and modified. Another added variable is time. Files may be "non-volatile" for a period of time after creation or during certain times of day. This would prevent an after-hours
5 assault on a computer network from damaging files stored thereon.

Recycle bin retention is another policy-based issue. It may be desirable to maintain an index of all files deleted from a recycle bin, or this may be unnecessary. If necessary, the index is stored as part of the recycle bin and may itself be archived at intervals or when of sufficient size to free up space in the recycling bin drawer 25. Other
10 variables affecting policies include size capacity and a number of files relating to each drawer.

Another policy that affects either a cabinet or its drawers is the quota on user space. Quotas are enforced on a user basis. This is based on a unique User or Group identifier. A maximum amount of storage space and a maximum quantity of files is
15 controllable. This Quota may be enforced at different levels such as, on a drawer-by-drawer basis or on a cabinet wide basis or even on an entire virtual volume basis.

As such, the functions currently handled manually by each individual user of a system are handled automatically. Since archiving storage media are cheaper than active
20 storage media, the system results in considerable cost savings. Further, since none must waste time in ensuring the policies of the virtual cabinet, in contrast to a file clerk who performs these functions for physical file cabinets, there is cost savings in the policy based organisation structure.

In the exemplary embodiment, a messaging system is implemented to route error
25 and other messages to appropriate entities. An example of the problem is as follows: if a file is not accessed for 30 days and is being transferred to the archiving drawer 24 and an error occurs, who gets the error message?

Notification of breach of security attempts as well as operator requests are routed to the designated entities according to pre-defined policies. These policies are modified

and managed by designated personnel. Notification policies are optionally defined for each of the actions taken by the system to enable auditing, trouble shooting, configuration management as well as system optimization. The notification process allows for numerous notification messages across different protocols with varying levels of severity to be declared for different errors and warnings. For example, the offline media management process optionally has one of a number of predefined policies;

If a specific user or user group requests access for a file that is located on a media that is currently offline then

- Pause the request indefinitely;
 - Notify the user that the file is currently is offline or not,
 - Allow the user to cancel the request,
 - Notify the operator or administrator that there is an outstanding request for an offline media when applicable,
 - Allow the administrator or operator to cancel the request,
 - Notify the user that the request was cancelled when applicable,

But this need not be so.

- Pause the request for a specified time period:
 - Notify the user that the file is currently offline when this is so,
 - Notify the user of the request time out period when applicable,
 - Allow the user to cancel the request,
 - Notify the operator or administrator that there is an outstanding request for an offline media,
 - Allow the administrator or operator to cancel the request,

- Notify the user that the request was cancelled,
- If the request timed out then;
 - Notify the operator or administrator that there is an outstanding request for an offline media that timed out,
 - Notify the user that the request timed out,

Of course other variations are also applicable and user notification is often optional as is the option to cancel a request.

- Fail the request immediately:

- Notify the user that the file is currently offline and inaccessible,
- Notify the operator or administrator that there was a cancelled request for a file located on an offline storage media,
- Notify the user that the request was cancelled,

Therefore, these errors are trapped and are passed onto an administrator of the cabinet or of the virtual volume. Messages may also be routed to users/groups according to predefined policies. A hierarchy of notifications is typically implemented to determine whom to notify. An example of a hierarchy is operators, file owners, group administrators, drawer administrators, cabinet administrators, and volume administrators. Also, notification to other parties such as individual users is possible based on policies and a status of a requested file or file operation. Optionally, notification is sent to the user requesting the file(s) irrespective of the operating environment.

In the virtual cabinet of Fig. 2, there is shown an offline drawer 26. Offline media require management policies of their own. In particular, those virtual drawers that may be offline, need policies relating to that event. This is analogous to physical drawers that may be locked. When the drawer is locked, provision is made for files outside the drawer belonging therein and for files within the drawer that are needed.

Before setting a drawer offline, policies are reviewed to determine that the drawer is one supporting offline activity and that according to preset policies; the drawer can be taken offline at present. Similarly, policies are verified before a drawer that is offline is returned to online operation. These policies may be significantly more complex than a lock and key scenario. A drawer may automatically go off line in some situations – security breaches, too much activity, reorganisation, etc. That same drawer may require certain events before returning online. In the case of security concerns, an indication from a trusted individual that security concerns are not real is commonly required. This may require a password or some other identification code. Even once restored, the restoration may not restore the drawer to full information accessibility as before. There may be time periods of partial availability or other policies to enhance security or to improve performance.

Preferably, information is logged relating to virtual cabinet operations for later use in trouble-shooting, tune-up and optimization purposes.

Another drawer (not shown) is a Mount-point drawer or cabinet reflecting data for retrieval from a communication medium in the form of the Internet. This drawer/cabinet may have, for example, known world wide web information addresses stored therein indicative of information location(s) for retrieval. Thus, accessing this drawer/cabinet provides a user with commonly available but updated information such as exchange rates, associated company data for contacting them, weather and traffic information and so forth. Instead of storing this data locally, it is stored on the World Wide Web but accessed as if it were in the local electronic file cabinet. Typically, this data is not managed using the lifecycle management method of the virtual cabinet/drawer since it is drawn from somewhere else, from a system belonging to someone else. That said, the inclusion of the data in a local virtual drawer/cabinet is beneficial in simplicity of access and up to date information content.

Another virtual cabinet may be a Read-Only cabinet that may contain data created outside the context of the virtual volume/cabinet/drawer. This data could be contained on distribution media such as CD-ROM/CD-R/DVD-R/DVD-ROM. Such a cabinet would

be in a read-only state, even though it might contain a cache drawer as well as an offline media drawer and potentially a number of read-only drawers. This implies that data contained on such read-only media may be indexed, cross-referenced and cached by the virtual volume for quick access and incorporated into the virtual volume.

5

Though a virtual drawer is described as being entirely within a single virtual directory, this virtual directory could be a single physical directory. Alternatively, the files are inside a single physical subdirectory absent a virtual directory. Further alternatively, the files are inside a plurality of physical and virtual subdirectories.

10

In an alternative embodiment, the file cabinet is formed of physical volumes instead of virtual volumes wherein a cabinet is comprised of a plurality of drawers each associated with a physical storage device.

15

In an embodiment, many Virtual Cabinets may share a single Virtual Drawer. As such, using any of several virtual cabinets provides access to a same virtual drawer. This allows for system load balancing wherein virtual drawers are shared to allow a predetermined amount of load on each physical storage device within each virtual device. As such, portions of a physical storage device are associated with different drawers in order to balance the load such that access to the drawers is optimized for speed.

20

Because of the structure of the virtual cabinet, existing data stored on electronic media is easily incorporable within newly created virtual volumes and virtual cabinets.

25

Referring to Fig. 5, a simplified diagram of an implementation of the system is shown. Here all native file system features are supported, but this need not be so. The filing cabinet has tremendous expandability. When using 64 bit addressing the virtual volume is expandable to $2^{64} - 1$ partitions and files. This is a very large number. Expansion of the volume or of the cabinets or drawers optionally takes place on the fly or on demand.

Partitions are formatted in the native file system format such as NTFS and are allocated from an appropriate Media Pool, but this need not be so.

Administrative processes allow for compacting of information on members.

- 5 Empty media remain allocated to the virtual volume. Optionally, these members may be automatically or manually removed once emptied, depending on a pre-defined policy.

- Further administrative options allow definition of different techniques to optimize removable media usage, balancing between performance and storage space utilization such as selecting options, i.e.: always write contiguously - split to utilize available space -
 10 split only when file size exceeds media size. Specialized caches for read, write or both operations are provided.

Each virtual volume supports pre-migration techniques for off-peak hours and pre-fetch techniques for improving scheduling.

The implementation supports several storage types including:

- 15 Fixed: Hard disk partitions – RAID, Flash disks. (SCSI, IDE Fibre Channel, etc.)
- Removable: MO – WORM – DVD-RAM – DVD-ROM – DVD-R – DVD+RW
 – Tape

- A local or remote server provides these services. The complete range of native operating system security features are supported. Further security features relating to
 20 policies of the virtual cabinet are also supported. The native operating system security features and the policies are enforced at a file level and a directory level.

- The invention supports mirroring merely by setting mirroring policies for particular drawers. This is typically achieved using two or more physical media for storing identical data. Of course, the use of an archiving medium and a cache allows for
 25 data to be mirrored in an archiving medium during use without slowing performance of the system. Similarly, should a portion of the storage medium fail, the mirrored data is retrieved from the archiving storage medium into the cache for rapid access. Mirroring is

neither limited nor confined to different drawers of different media types, but rather is a policy that allows files to be mirrored to similar typed drawers as well or instead.

Further, the archiving storage device is then an accurate replica of the data that is useful as an archive or for data transfer. Further, the use of several archiving storage media is supported to form a plurality of replicas on different media. Optionally, replication is performed between drawers of a same type enabling the files to be accessed at all times with same identical performance.

Optionally, a journaling file system is implemented to make rebuilding of data for faster recovery in case of storage device failure. Preferably, concurrent access is provided during data rebuild. Alternatively stated, as data is being scanned, already parsed information is available to users, typically, in a read-only state. The basic concept of metadata regeneration is achieved by reconstructing the metadata from the individual components that make up the virtual drawers/cabinets and virtual volumes. The metadata is replicated, either partially or fully, through out the virtual volume on the individual components, allowing the metadata to be regenerated in its entirety from these components, but this need not be so. The metadata may be replicated or even mirrored on the local server or across the network to another set of storage components, perhaps an identical set to the original, that would provide plurality of access and enhance performance and provide a redundant fail over mechanism.

Referring to Fig. 6, a simplified flow diagram of a method of using retention dates to track file lifecycles is shown. File expiration dates are stored in association with each file. The expiration dates are indicative of a minimum time before deletion, if any; a date on which to delete the file; and any policies relating to the deletion such as archiving or moving the file to other storage media and so forth. Retention policies within a drawer effect the expiration dates. For example, every time a file is accessed, the retention date is updated. The update may differ depending on the access type – read, write, copy, etc. – or may remain the same across all access functions. Also, the policies are capable of supporting distinctions based on user identifications, file types, security levels, and so forth. Another example would allow files that are no longer required for the organization

to expire after they reached the legal statute of limitations to be disposed of automatically without delay.

The pseudo file system uses expiration dates on files to track the use of the file. The expiration dates aid the disposal of seldom-used files, selecting them to be backed up
5 and/or deleted from the virtual drawer. A minimum and a maximum retention period are specified for the files in the volume.

To determine the expiration date of a newly created file the maximum retention time value is added to the current time, and every time the file is accessed or modified its expiration is updated with a minimum retention time value + current time if it is after the
10 previously stored expiration date. On the other hand expiration policies could be defined to allow files to expire based on strictly the creation date, but this need not be so.

Similarly, a volatility period for a file is selectable during which a user is unable to delete the file. Optionally, the volatility period is stored with an indication preventing renaming of the file when set and allowing it when cleared.

Also, with each file are stored policies on file deletion within the scope of those
15 policies supported by the virtual drawer. Policies for file deletion include the following: delete with security; delete without security; delete with archive; prevent deletion but allow renaming; prevent deletion prevent renaming; send to recycle bin; maintain version control data; and delete prior versions.

Version control is a significant aspect of file lifecycle management. When a file is
20 modified, a new version is created. The newer version may be created by duplicating and modifying the previous file and maintained as a completely intact file or as a differential file relative to the previous version of the file. The previous version is typically discarded – replaced or deleted. This need not be so. Policies on file retention can maintain
25 previous versions and if so desired, will maintain a list of previous versions including when last modified and by whom. These old versions are typically stored throughout the virtual cabinet and exist in any drawer, according to the governing policies that are set by an administrator. Users may have access to only the most recent version of a file, but this

also need not be the case. Policies may limit a number of generated versions or an interval between new versions in order to limit storage requirements.

Typically, when version control is enabled, only a last file version is available other than by special request. When a file is opened for writing, a modification flag is maintained to ensure that new information has been written to the file. This reduces the amount of versions saved by eliminating those reflecting no changes. If the flag is set, a new version of the file is created – a copy - and the data is stored in this new file. Typically, a version identifier is maintained as a sequential number included in the file ID and is incremented every time a new version is created. Of course, other forms of version numbering such as date and time and so forth are also possible. Preferably, in the file properties list, the history of modifications to a file stored through version control appears. Depending on the governing policies set by the administrator and the underlying operating system, the different versions of the file may be visible to the user but this need not be so.

Another version control policy is Selective/discretionary version control. Selective version control is a suitable file retention policy to thin versions of a file based on age such that, for example, one version per week is stored for versions over one month old and one version a day is stored for versions over a week old and one version an hour is stored for versions less than one week and over one day, and finally all versions are stored for the last day. By selectively reducing the number of versions maintained, storage requirements do not balloon while, for most applications, reasonable version control is maintained.

Of course, once the file is moved to the archiving drawer 24, the older versions are archived since they are unlikely to be accessed. Similarly, if the file is moved to the recycle bin, the older versions may be archived, deleted, or moved to the recycle bin with the file.

The invention embodies a complete suite of access rights that any administrator may define which will be enforced by the system. They allow the administrator to specify who can perform a specific administrative task if any, and who will get notified in the

case of a particular event or for all events and how. The enforcement of access rights may be completely or partially disabled at the administrator's discretion, or who ever is designated with the privilege to do so. Every aspect of the system is configurable.

- 5 Numerous other embodiments may be envisaged without departing from the spirit or scope of the invention.

Appendix A:**Virtual Volume:**

Name
 Volume Label (Same as Name)
 Metadata Information (partition list)
 Data Members (partition list)
 Space available – Maximum number of files
 Scan Parameters (schedule info)

Virtual Cabinet:

Name = Subdirectory name (always linked to the directory ID)
 Path Selector (where the VC is located)
 File Retention Policies

Automatic Deletion
 Prevent Deletion (Access Control Rules)

Recycle Bin

Version Control

Movement Rules between Virtual Drawers

Move from Source-DR to Destination-DR files in <criteria>.

<criteria> ::=

Any File

Include only files that match (Age, Size, Attributes, File-Mask,
 User/Owner/Creator) [alo]

All files, **excluding** files that match (Age, Size, Attributes, File-Mask)
 [alo]

Age:

n days since (CRT, LMT, LAT)

Attributes:

Read-Only/Archive/Hidden/System/Compressed (disabled)

Size:

Files smaller than n [size unit]

Files larger than n [size unit]

File-Mask:

Name pattern/extension pattern

User/Owner/Creator

Files created by a particular user or Group

Files whos ownership is currently held by a specific user or user

group

File will always be created in one of the virtual cabinet's drawers according to a pre-defined policy.

Virtual Drawer:

Name

Server:

Local/Remote

Class:

Class: Cache - Storage – Mountpoint

Function:

Primary Storage – Recycle – Replica – Backup – Mirror – Archive –

Offline Media

Type:

Fixed/Removable (Online – Nearline)

Media:

Magneto Optical / WORM / DVD-RAM / DVD-ROM / DVD-R/ DVD+RW /
TAPE / CD-ROM / CD-R / FLASH / RAM

Replication / Mirroring

Drawer Access Mode (Read/Write (RW), Read-Only (RO), Archive Mode [AM])

Primary Media Pool

Rules for taking Offline (weighting factors, automatically, etc.) – Storage location

Rules for Restoration (messaging thru Notification Mgr)

Status:

Online – Offline – Locked – Unlocked – Mirror-Synchronization –

Replication-In-progress – Backup-In-progress – Accessible – Inaccessible

Shared:

Private – Public

Virtual Volumes	Virtual Drawers	Virtual Cabinets	Virtual Drawers in a Virtual Cabinet
Name = Volume Label	Name	Name = Subdirectory	Movement Rules
	Control: Native -Foreign	Path Selector(s)	Recycle Bin Policies
Scan Parameters	Location: Local -Remote		Cache Policies
User/Group Quotas	Class: Cache - Storage – Mountpoint	Automatic Deletion Policies	Scan Policies
	Type: Fixed – Removable	Version Control Policies	User/Group Quotas
	Media: HD – FLASH – MO – WORM – CD-R – CD-ROM – DVD-RAM – DVD-ROM – DVD-R – DVD+RW – RAM - TAPE	Access Mode: Read/Write – Read-Only – Archive Mode	
	Access Mode: Read/Write – Read-Only – Archive Mode	Security Deletion Policies	
Status: Online – Offline – Locked – Unlocked – Mirror-Synchronization – Replication-In-progress – Backup-In-progress – Accessible – Inaccessible	Status: Online – Offline – Locked – Unlocked – Mirror-Synchronization – Replication-In-progress – Backup-In-progress – Accessible – Inaccessible	Status: Online – Offline – Locked – Unlocked – Mirror-Synchronization – Replication-In-progress – Backup-In-progress – Accessible – Inaccessible	
	Primary Media Pool Shared or Not shared	Type: Virtual Directory – Mount-point/Symbolic-link	
	Default Storage Location		
	Function: Primary Storage – Recycle – Replica – Backup – Mirror – Archive – Offline Media		
	Share: Public – Private	User/Group Quotas	
	Taking Offline Policies		
	Restoration Policies		
	High / Low Watermarks		
	Drawer Direct Access (Read/Write)		

Table 1: VIRTUAL VOLUMES: PROPERTIES - ATTRIBUTES – POLICIES

Claims

What is claimed is:

- 5 1. A method of managing a file lifecycle comprising the steps of:
storing the file on a storage medium having associated therewith a set of policies relating
to file storage locations;
automatically determining from the associated policies when the file is to be moved; and,
moving the file to another storage location within a same or different storage medium
10 when the file is to be moved.
2. A method of managing a file lifecycle according to claim 1 comprising the steps of:
providing a plurality of storage media including the storage medium, each having
associated therewith a set of policies, the policies such that when a condition is met the
15 file is transferred from one storage medium to another in accordance with a lifecycle
stage of the file.
3. A method of managing a file lifecycle according to claim 2 wherein a first storage
medium is associated with active files and a last storage medium is associated with
20 archived files and wherein the file is transferred from the first storage medium to the last
storage medium in successive stages.
4. A method of managing a file lifecycle according to claim 3, wherein a file is
automatically transferred to a storage medium most appropriate for its stage of lifecycle
25 determined in accordance with the policies.
5. A method of managing a file lifecycle according to claim 4 wherein the policies relate
to at least some of the associated storage medium, the file name, the file extension, the
file creation date, the file access date, the file last access date, the file creator, and the
30 current file owner .

6. A method of managing a file lifecycle according to claim 1 wherein the step of storing the file on a storage medium comprises the step of determining, in accordance with the policies, expiration data relating to when the file is to be moved.

5 7. A method of managing a file lifecycle according to claim 6 wherein the step of automatically determining when the file is to be moved comprises the step of comparing the expiration data to present time data to determine if it is indicative of the file having expired its time on the storage medium or on the entire system.

10 8. A method of managing a file lifecycle comprising the steps of:
providing a virtual storage medium having a plurality of storage media associated
therewith and having associated therewith a set of policies relating to file storage
locations within the storage media;
storing the file on a storage medium within the virtual storage medium;
15 at intervals, determining from the associated policies actions dictated by the policies for
performance on the file; and,
performing the dictated actions on the file.

20 9. A method of managing a file lifecycle according to claim 8 wherein a first storage
medium is associated with active files and a last storage medium is associated with
archived files and wherein the file is transferred from the first storage medium to the last
storage medium in successive stages.

25 10. A method of managing a file lifecycle according to claim 9, wherein a file is
automatically transferred to a storage medium most appropriate for its stage of lifecycle
determined in accordance with the policies.

30 11. A method of managing a file lifecycle according to claim 10 wherein the policies
relate to at least some of the associated storage medium, the file name, the file extension,
the file creation date, the file access date, the file last access date, the file creator, and
the current file owner.

12. A method of managing a file lifecycle according to claim 8 wherein the step of storing the file on a storage medium comprises the step of determining, in accordance with the policies, expiration data relating to when the file is to be moved.

5

13. A method of managing a file lifecycle according to claim 12 wherein the step of automatically determining when the file is to be moved comprises the step of comparing the expiration data to present time data to determine if it is indicative of the file having expired its time on the storage medium.

10

14. A method of managing a file lifecycle comprising the steps of:
providing a virtual cabinet having a plurality of virtual drawers, each virtual drawer associated with at least a storage medium and a single drawer associated with storage media of a similar nature;

15

providing a plurality of policies, a policy associated with each virtual drawer;
storing the file in a virtual drawer by storing the file on at least a storage medium associated with the virtual drawer;
at intervals, determining from the policy associated with the virtual drawer an action dictated by the policy; and,

20

performing the dictated action on the file.

15. A method of managing a file lifecycle according to claim 14 wherein the action includes the step of deleting the file from the virtual drawer.

25

16. A method of managing a file lifecycle according to claim 15 wherein the policies relate to the storage medium and to dates stored in association with each file.

17. A method of managing a file lifecycle according to claim 16 comprising the step of: storing in association with each file an expiration indicator indicative of when the file is

30

to be transferred.

18. A method of managing a file lifecycle according to claim 17 wherein the expiration indicator includes a date on which to delete the file from the drawer in accordance with the action dictated by the policy.

5 19. A method of managing a file lifecycle according to claim 17 wherein the expiration indicator includes a minimum time before which the file is to be maintained in its current drawer.

10 20. A method of managing a file lifecycle according to claim 15 wherein the action includes the step of transferring the file from the virtual drawer to another different virtual drawer within the cabinet.

15 21. A method of managing a file lifecycle according to claim 20 wherein step of transferring the file includes the step of archiving the file within an archiving virtual drawer.

20 22. A method of managing a file lifecycle according to claim 15 wherein step of deleting the file includes the steps of determining based on a policy associated with the drawer and based on data stored in association with the file a mode of deletion, and deleting the file in accordance with the determined mode.

23. A method of managing a file lifecycle according to claim 22 wherein the modes of deletion include secure deletion and insecure deletion.

25 24. A method of managing a file lifecycle according to claim 14 wherein files stored in the virtual cabinet are stored within a same virtual storage medium and wherein files stored within each drawer from the plurality of virtual drawers are stored on the one or more similar storage media associated with said drawer.

30 25. A method of managing a file lifecycle according to claim 24 wherein a single virtual drawer forms part of a plurality of virtual cabinets.

26. A method of managing a file lifecycle according to claim 14 wherein the step of determining an action comprises the steps of:

determining from the policy a condition;

- 5 evaluating each file to determine a presence of the condition; and,
when the condition is met, providing an action associated with the condition as the determined action.

27. A method of managing a file lifecycle comprising the steps of:

- 10 providing a virtual cabinet having a plurality of virtual drawers, each virtual drawer associated with at least a storage medium and a single drawer associated with storage media of a similar nature;

providing a plurality of policies, a policy associated with each virtual drawer;

- 15 storing the file in a virtual drawer by storing the file on at least a storage medium associated with the virtual drawer;

upon receiving an access request to access the file, determining from the policy associated with the virtual drawer an action dictated by the policy; and,
performing the dictated action on the file.

- 20 28. A method of managing a file lifecycle according to claim 27 wherein the determined action comprises the step of: storing in association with each file an expiration indicator indicative of when the file is to be transferred, the expiration indicator determined based on the policy.

- 25 29. A method of managing a file lifecycle according to claim 28 wherein the expiration indicator includes a date on which to delete the file from the drawer in accordance with the action dictated by the policy.

- 30 30. A method of managing a file lifecycle according to claim 28 wherein the expiration indicator includes a minimum time before which the file is to be maintained in its current drawer.

31. A method of managing a file lifecycle according to claim 27 wherein the action includes the step of transferring the file from the virtual drawer to another different virtual drawer within the cabinet.

5

32. A method of managing a file lifecycle according to claim 31 wherein step of transferring the file includes the step of retrieving the file from an archiving virtual drawer and storing it in another virtual drawer.

10 33. A method of managing a file lifecycle according to claim 27 comprising the steps of determining based on a policy associated with the drawer and based on data stored in association with the file whether the file is to be deleted;
determining based on a policy associated with the drawer and based on data stored in association with the file a mode of deletion for the file; and
15 deleting the file in accordance with the determined mode.

34. A method of managing a file lifecycle according to claim 33 wherein the modes of deletion include secure deletion and insecure deletion.

20 35. A method of managing a file lifecycle according to claim 27 wherein files stored in the virtual cabinet are stored within a same virtual storage medium and wherein files stored within each drawer from the plurality of virtual drawers are stored on the one or more similar storage media associated with said drawer.

25 36. A method of managing a file lifecycle according to claim 35 wherein a single virtual drawer forms part of a plurality of virtual cabinets.

37. A method of managing a file lifecycle according to claim 27 wherein the step of determining an action comprises the steps of:

30 determining from the policy a condition;
evaluating the accessed file to determine a presence of the condition; and,

when the condition is met, providing an action associated with the condition as the determined action.

38. A method of managing a file lifecycle comprising the steps of:

- 5 providing a virtual storage medium having a plurality of storage media associated therewith and having associated therewith a set of policies relating to file storage locations within the storage media;
storing the file on a storage medium within the virtual storage medium;
upon occurrence of a triggering event, determining from the associated policies actions
10 dictated by the policies for performance on the file; and,
performing the dictated actions on the file.

39. A method of managing a file lifecycle according to claim 38 wherein a first storage medium is associated with active files and a last storage medium is associated with
15 archived files and wherein the file is transferred from the first storage medium to the last storage medium in successive stages.

40. A method of managing a file lifecycle according to claim 39, wherein a file is automatically transferred to a storage medium most appropriate for its stage of lifecycle
20 determined in accordance with the policies.

41. A method of managing a file lifecycle according to claim 40 wherein the policies relate to at least some of the associated storage medium, the file name, the file extension, the file creation date, the file access date, the file last access date, the file creator, and
25 the current file owner .

42. A method of managing a file lifecycle according to claim 38 wherein the step of storing the file on a storage medium comprises the step of determining, in accordance with the policies, expiration data relating to when the file is to be moved.

30

43. A method of managing a file lifecycle according to claim 42 wherein the step of automatically determining when the file is to be moved comprises the step of comparing the expiration data to present time data to determine if it is indicative of the file having expired its time on the storage medium.

5

44. A method of managing a file lifecycle according to claim 38 wherein the event relates to an amount of free space on the storage medium.

10

45. A method of managing a file lifecycle according to claim 38 wherein the event relates to an amount of space occupied by files of an individual compared to a quota of space allocated to that individual.

15

46. A method of managing a file lifecycle according to claim 38 wherein the event relates to at least one of initial storage of a file and modification of said file.

20

47. A method of managing a file lifecycle comprising the steps of:
requesting a file to be stored in a virtual cabinet in a virtual volume;
evaluating the file storage criteria based on cabinet policies of the virtual cabinet to determine a physical location wherein the file is to be stored; and,
storing the file in the determined physical location.

48. A method of managing a file lifecycle according to claim 47 wherein the cabinet policies relate to file types of the file to be stored.

25

49. A method of managing a file lifecycle according to claim 48 wherein a virtual cabinet comprises a virtual drawer and wherein a virtual drawer forms part of more than one virtual cabinet.

30

50. A method of managing a file lifecycle according to claim 49 wherein the virtual cabinet forms a context within a context based file lifecycle management system and

wherein a file created within a context of a virtual cabinet being subject to the policies of said virtual cabinet.

51. A method of managing a file lifecycle according to claim 47 wherein the step of
5 storing the file comprises the step of storing the file in association with the virtual cabinet.

52. A method of managing a file lifecycle according to claim 51 wherein the file is
governed by policies of the associated virtual cabinet and wherein some actions dictated
10 by those policies are performed on the file throughout its lifecycle.

53. A method of managing a file lifecycle comprising the steps of:
selecting a virtual drawer within a virtual cabinet;
requesting a file to be stored in the virtual drawer; and,
15 evaluating the file storage criteria based on policies associated with the virtual cabinet;
in accordance with the file storage criteria, storing the file in association with the virtual cabinet.

54. A method of managing a file lifecycle according to claim 53 wherein the file is stored
20 within the virtual drawer and is accessible within the virtual drawer within each of a plurality of virtual cabinets.

55. A method of managing a file lifecycle according to claim 53 wherein the policies
relate to duplication of file data within a plurality of files.

25 56. A method of managing a file lifecycle according to claim 55 wherein the policies relate to load balancing for the virtual cabinet based on access to data that is stored in duplicate.

57. A method of managing a file lifecycle according to claim 53 wherein the policies relate to one of replication, backup, mirroring, and redundancy of file data storage within the virtual cabinet.

5 58. A method of managing a file lifecycle according to claim 57 wherein the policies relate to load balancing for the virtual cabinet based on access to data that is stored in more than one physical location.

10 59. A method of managing a file lifecycle according to claim 53 wherein the policies relate to one of version control.

Abstract of the Disclosure

A method and system for managing a file lifecycle is disclosed. The method incorporates a virtual file cabinet having virtual drawers. Files are moved from drawer to drawer throughout their lifecycle in accordance with policies associated with each
5 drawer. The files are moved automatically and as such, a file's lifecycle is managed from file creation to file deletion in an automated fashion. By using an archiving device such as magneto optical storage media, the files are automatically moved to their final archived location in an archiving drawer once certain policies of their present drawer are met. The system is an electronic system employing the inventive method.

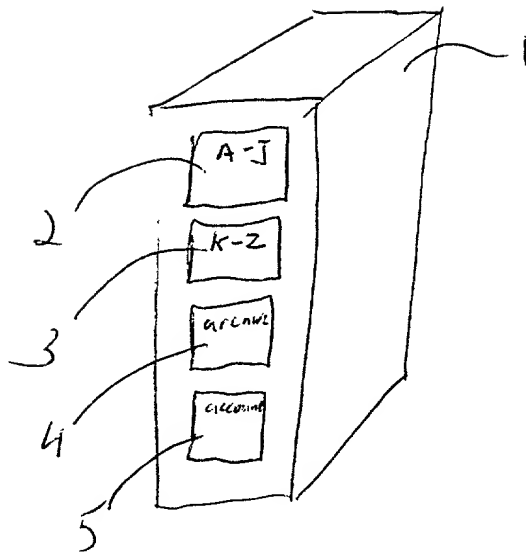
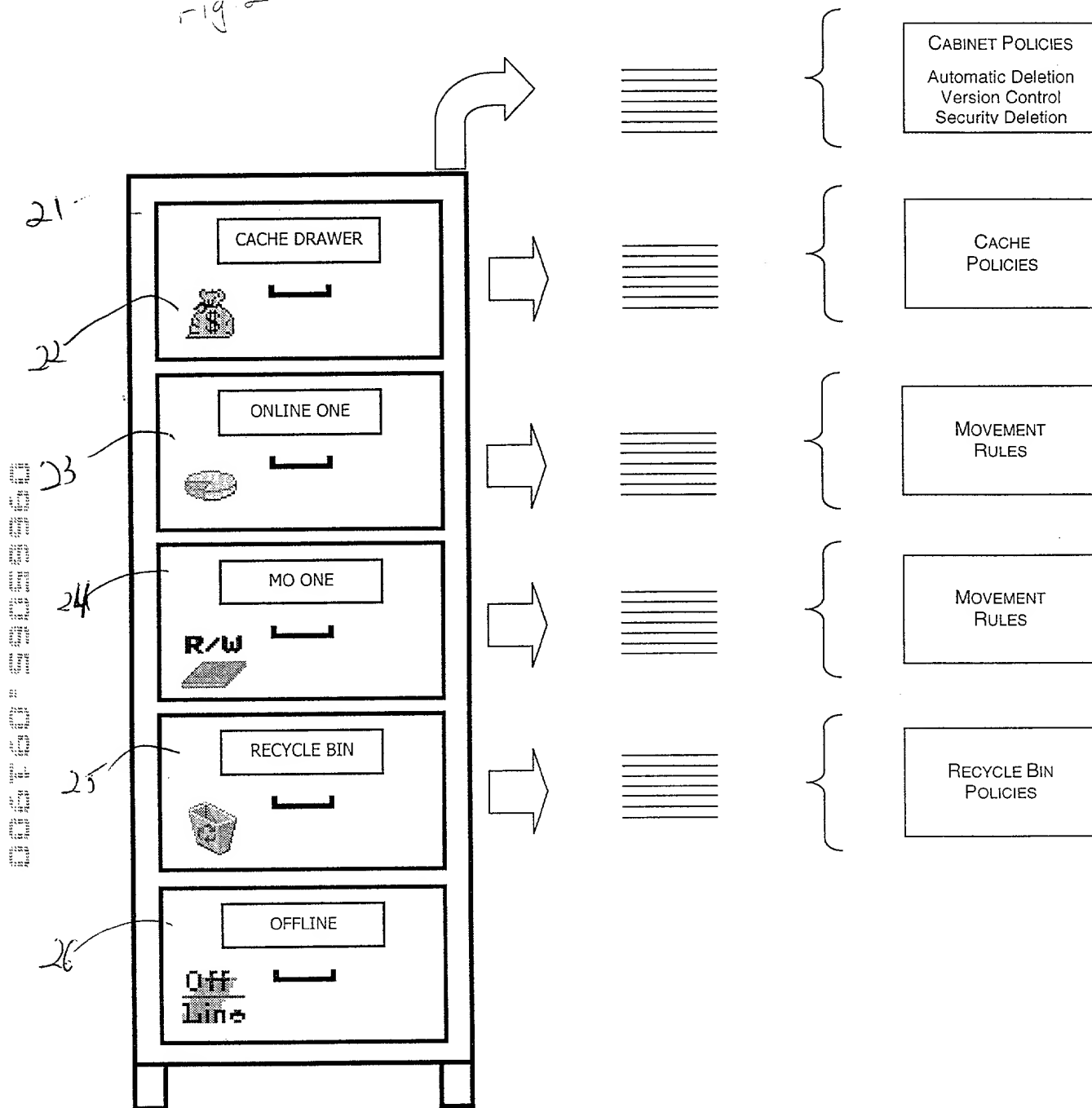


Fig. 1

VIRTUAL CABINET SCHEME

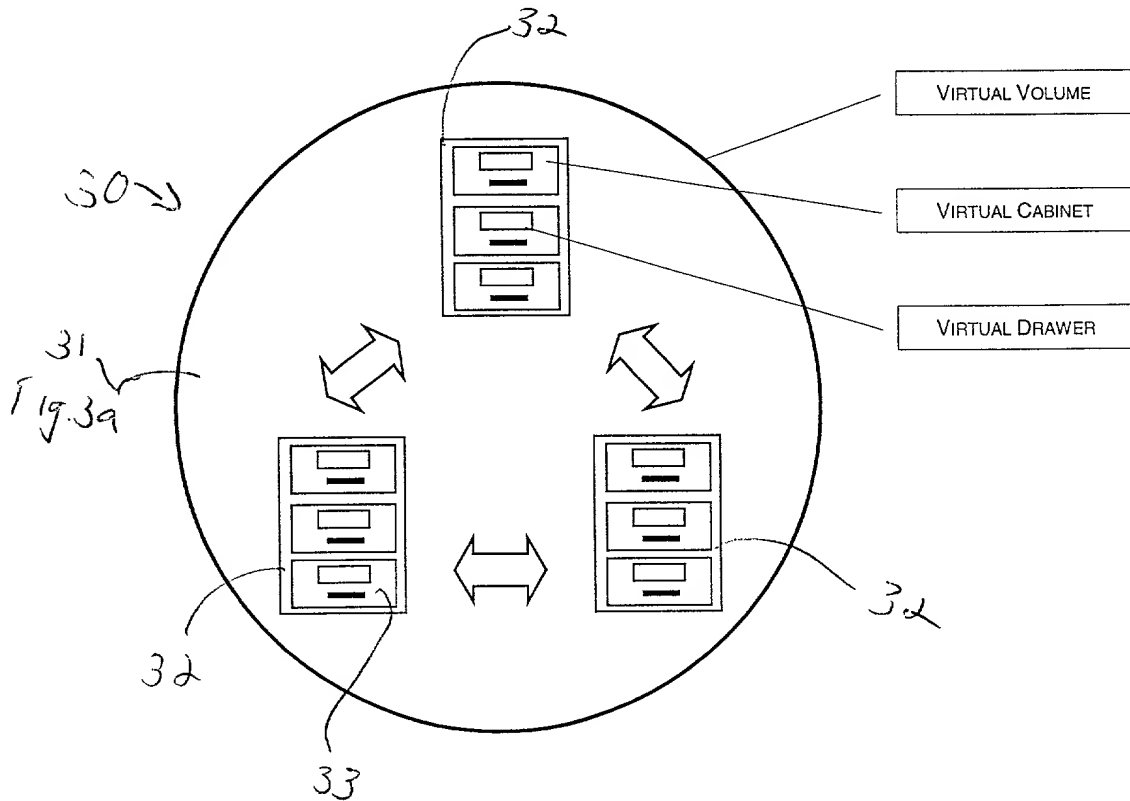
Fig 2



FILE LIFE CYCLE MANAGEMENT

Goal: To control a file from its inception, throughout all the stages of its life, to the end of its useful existence, safely ensuring information availability and simultaneously providing a cost effective storage place, according to predefined administration policies.

The File Life Cycle will be controlled by Virtual Cabinets. A Virtual Cabinet will define the whole set of policies for governing files inside a disk subdirectory. The cabinets will store files in Virtual Drawers. All these elements exist in a virtual storage space: a Virtual Volume.



Files will be stored inside of Virtual Drawers. These drawers can expand and shrink dynamically and will be constituted by a homogeneous media type. Besides storage, Virtual Drawers can be defined for extra purposes like caching, redundancy control, file recycling and offline management.

Each Virtual Cabinet will contain the general policies to be applied for the files under its control; in turn, each Virtual Drawer in a cabinet will include the rules for administering files in its domain.

Furthermore, a Virtual Drawer can be shared by many Virtual Cabinets.

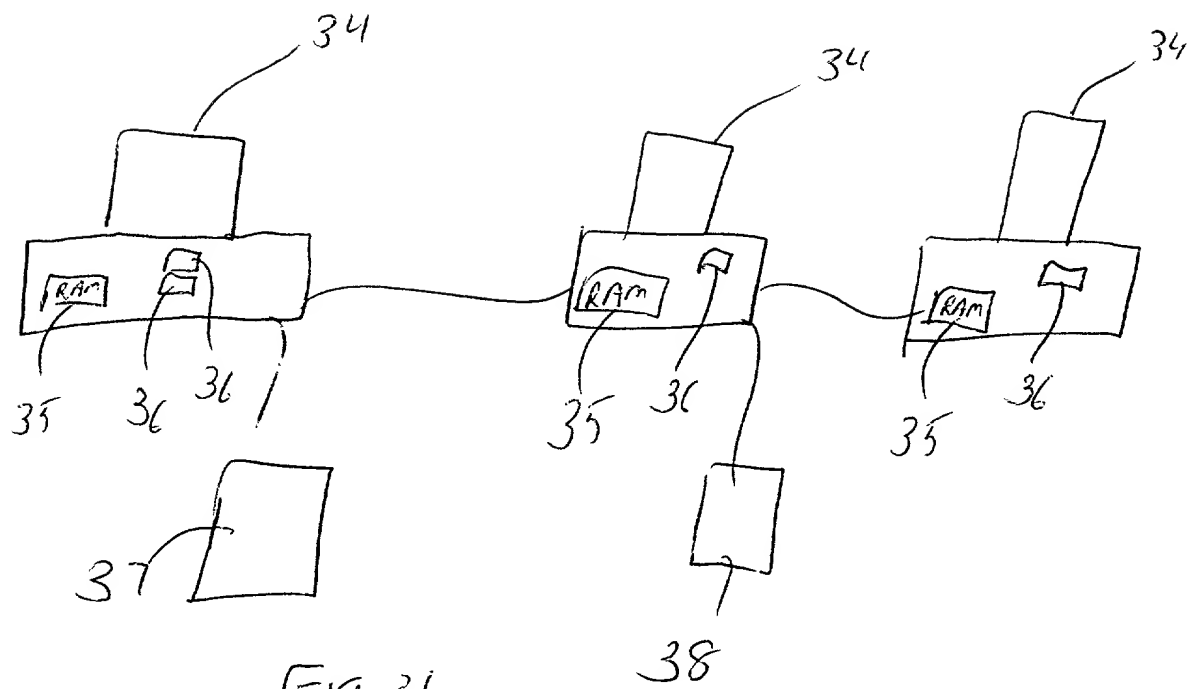


Fig. 36

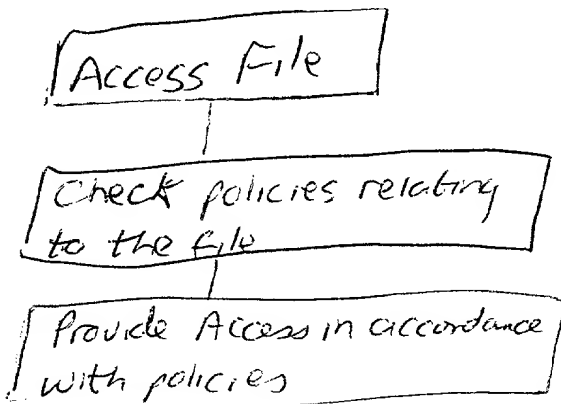
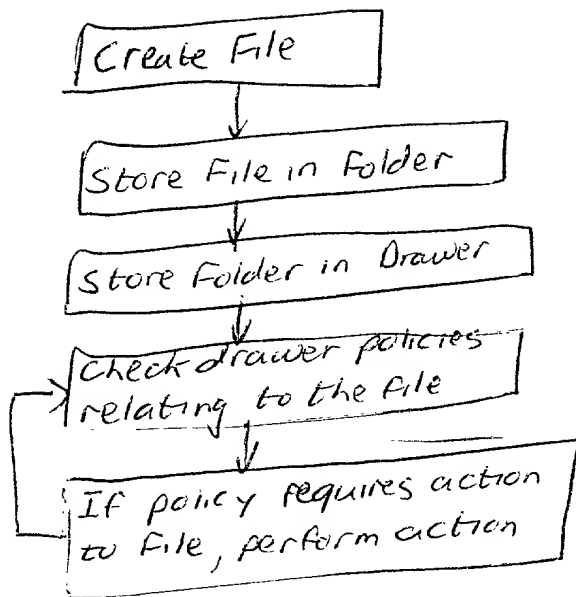


Fig. 4

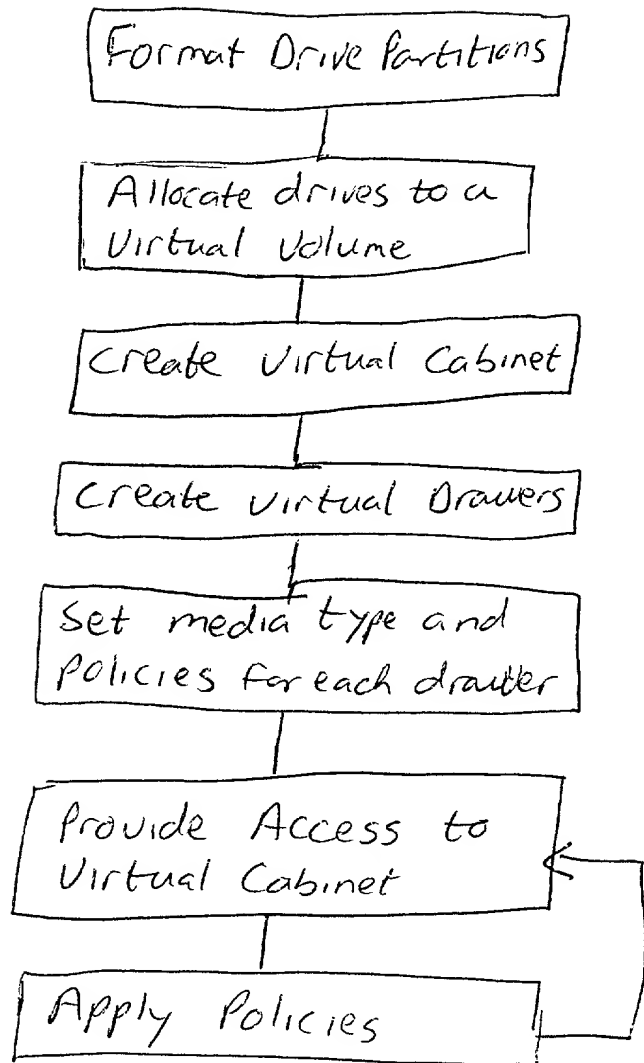
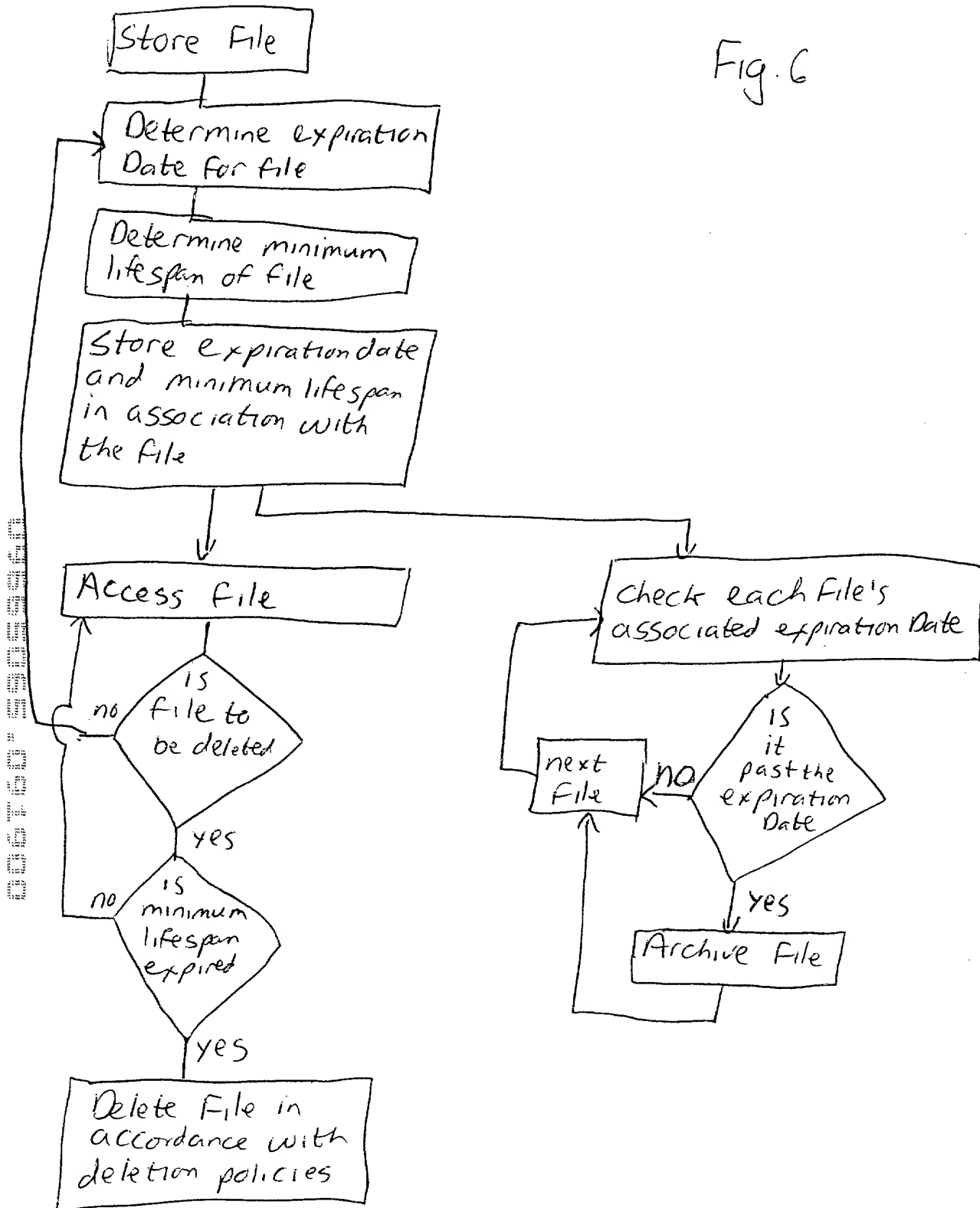


Fig. 5

recycle bin policies
mirroring of drawers
drawer security
File migration
journaling

Fig. 6



**DECLARATION FOR UTILITY OR
DESIGN
PATENT APPLICATION
(37 CFR 1.63)**

☒ Declaration Submitted With Initial Filing OR ☐ Declaration Submitted After Initial Filing (37 CFR 1.16(e) Required)

Attorney Docket Number

88-06 US

First Named Inventor

SHAATH

COMPLETE IF KNOWN

Application Number

Filing Date

Group Art Unit

Examiner Name

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND SYSTEM FOR ELECTRONIC FILE LIFECYCLE MANAGEMENT

the specification of which ☒ is attached hereto OR

☐ as filed on (MM/DD/YYYY) _____ as United States Application Number or PCT International Application Number _____ and was amended on (MM/DD/YYYY)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

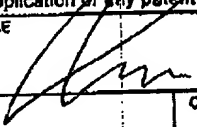
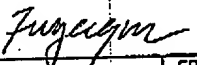

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365 (b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? Yes No

☐ Additional foreign application numbers are listed on a supplementary priority data sheet (PTO/SB/02B) attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

DECLARATION - Utility or Design Patent Application		Attorney Docket No. 88-06 US
I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT International application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.		
U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)
As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:		
GORDON FREEDMAN, REG. NO. 41,553		
Address all correspondence to: Freedman & Associates 117 Centrepointhe Drive Suite 350 Nepean, Ontario, K2G 5X3 Canada		
Address all telephone calls to: Gordon Freedman - 613-274-7272		
I hereby declare that all statements made herein of my own knowledge are true and that all statements were made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements of the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and such willful false statements may jeopardize the validity of the application or any patent issued thereon.		
FULL NAME OF SOLE OR FIRST INVENTOR	SIGNATURE	DATE
Kamel SHAATH		15, Sept, 2000
RESIDENCE	CITIZENSHIP	
149 McCurdy Drive, Kanata, Ontario, Canada K2L 2Z7	CANADIAN	
POST OFFICE ADDRESS		
Same as residence address		
FULL NAME OF SECOND JOINT INVENTOR, IF ANY	SIGNATURE	DATE
Yaqun FU		Sept. 15, 2000
RESIDENCE	CITIZENSHIP	
59 Bayshore Drive #105, Nepean, Ontario, Canada K2B 7G8	CANADIAN	
POST OFFICE ADDRESS		
Same as residence address		
FULL NAME OF THIRD JOINT INVENTOR, IF ANY	SIGNATURE	DATE
Vinay PARTHASARATHY		15-9-2000
RESIDENCE	CITIZENSHIP	
2881 Richmond Road, Ottawa, Ontario, Canada K2B 8J5	INDIAN	
POST OFFICE ADDRESS		
Same as residence address		

DECLARATION - Utility or Design Patent Application		Attorney Docket No. 88-06 US	
FULL NAME OF FOURTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
Alexei JELVIS		<i>Moray</i>	<i>15 Sept 2000</i>
RESIDENCE 10-73 Woodbridge Crescent, Nepean, Ontario, Canada K2B 7T2		CITIZENSHIP RUSSIAN	
POST OFFICE ADDRESS Same as residence address			
FULL NAME OF FIFTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
Abel L. LIYANSKY		<i>Abel L. Liyansky</i>	<i>15-Sep-2000</i>
RESIDENCE 219-2055 Carling Avenue, Ottawa, Ontario, Canada K2A 1G6		CITIZENSHIP ARGENTINEAN	
POST OFFICE ADDRESS Same as residence address			
FULL NAME OF SIXTH JOINT INVENTOR, IF ANY		SIGNATURE	DATE
RESIDENCE		CITIZENSHIP	
POST OFFICE ADDRESS			